



US009543355B2

(12) **United States Patent**
Lu et al.

(10) **Patent No.:** **US 9,543,355 B2**
(45) **Date of Patent:** **Jan. 10, 2017**

(54) **DARK CURRENT REDUCTION FOR BACK SIDE ILLUMINATED IMAGE SENSOR**

(71) Applicant: **TAIWAN SEMICONDUCTOR MANUFACTURING COMPANY, LTD.**, Hsin-Chu (TW)

(72) Inventors: **Shou-Shu Lu**, Kaohsiung (TW); **Hsun-Ying Huang**, Tainan (TW); **Hsin-Jung Huang**, Kaohsiung (TW); **Chun-Mao Chiu**, Kaohsiung (TW); **Chia-Chi Hsiao**, Tianshong Township (TW); **Yung-Cheng Chang**, Zhubei (TW)

(73) Assignee: **Taiwan Semiconductor Manufacturing Company, Ltd.**, Hsin-Chu (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **14/822,051**

(22) Filed: **Aug. 10, 2015**

(65) **Prior Publication Data**

US 2015/0349009 A1 Dec. 3, 2015

Related U.S. Application Data

(60) Continuation of application No. 14/323,676, filed on Jul. 3, 2014, now Pat. No. 9,123,616, which is a (Continued)

(51) **Int. Cl.**
H01L 27/146 (2006.01)
H01L 31/028 (2006.01)

(52) **U.S. Cl.**
CPC **H01L 27/14687** (2013.01); **H01L 27/1462** (2013.01); **H01L 27/1464** (2013.01); (Continued)

(58) **Field of Classification Search**

CPC H01L 27/14687; H01L 27/14618; H01L 27/1462; H01L 27/14632; H01L 27/14636; H01L 27/1464; H01L 27/14683; H01L 27/14685; H01L 27/14621; H01L 27/14627; H01L 31/028; H01L 2924/0002

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,741,666 B2 6/2010 Nozaki et al.
8,848,075 B2 9/2014 Takahashi et al.
2011/0102657 A1* 5/2011 Takahashi H01L 23/481 348/308

FOREIGN PATENT DOCUMENTS

CN 102769021 A 11/2012
KR 10-2008-0079490 A 9/2008

(Continued)

OTHER PUBLICATIONS

Korean Intellectual Property Office, Notice of Allowance for Patent Application No. 10-2012-0039403, Nov. 24, 2014, 4 pages.

Primary Examiner — Whitney T Moore

(74) *Attorney, Agent, or Firm* — Haynes and Boone, LLP

(57) **ABSTRACT**

A method of fabricating a semiconductor image sensor device is disclosed. A plurality of radiation-sensing regions is formed in a substrate. The radiation-sensing regions are formed in a non-scribe-line region of the image sensor device. An opening is formed in a scribe-line region of the image sensor device by etching the substrate in the scribe-line region. A portion of the substrate remains in the scribe-line region after the etching. The opening is then filled with an organic material.

20 Claims, 9 Drawing Sheets

